The NASA SCI Files™
The Case of the
Disappearing Dirt

Segment 2

As the tree house detectives continue their search to discover what has happened to their favorite beach, Kali visits Mr. John Gruener at NASA Johnson Space Center in Houston, Texas. Using some interesting and edible props, Mr. Gruener helps Kali understand how the Earth recycles its materials to create new rocks and minerals. Mr. Gruener also suggests that Kali visit the Lunar Lab to learn more about rocks and to view some extra special rocks—Moon rocks! Ms. Andrea Mosi lets Kali explore the clean room where the Moon rocks are kept while scientists are working with them. She also explains to Kali that there are three different types of rocks: igneous, metamorphic, and sedimentary. Meanwhile, while fishing in Alaska, Tony asks for Dr. D's help to understand the difference between mechanical and chemical weathering. The tree house detectives are starting to put all the pieces together and hope that they will soon be able to solve the mystery of the missing sand!

Objectives

Students will

- compare weathering on the Moon and on Earth.
- identify the characteristics of igneous, sedimentary, and metamorphic rocks.
- observe how geodes are formed.
- demonstrate how plants break apart rocks.
- investigate the difference between mechanical and chemical weathering.
- demonstrate the effect of frost action on rocks.
- investigate oxidation as a process of chemical weathering.
- construct a model of the rock granite.

Vocabulary

agents of erosion – factors that cause erosion to happen, primarily wind, water, ice, and gravity

chemical weathering – the breaking up of rocks due to a change in chemical composition that occurs when water, air, and other substances react with the minerals in the rocks

dissolution – the process of chemical weathering in which rock is dissolved as part of the leaching process

erosion – the process that moves weathered rock and soil from one place to another

hydrolysis – when one or more minerals combine with water

igneous rock – rock formed from magma or lava when it cools

lunar – related to the Moon

mechanical weathering – the breaking up of rocks without changing their chemical composition

metamorphic rock – rock formed from existing rock by changes in temperature and pressure

oxidation – chemical weathering that occurs when a substance is exposed to oxygen and water

plate tectonics – the theory that the Earth's crust and upper mantle exist in sections called plates and that these plates slowly move around on the mantle

rock cycle – the process by which, over many years, Earth materials change back and forth among magma, igneous rocks, sedimentary rocks, and metamorphic rocks

sedimentary rock – rock formed when sediments become pressed or cemented together

sediment – loose materials such as rock fragments and mineral grains that have been transported by wind, water, or glaciers

weathering – the breaking of rocks into smaller pieces, either mechanically or chemically

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Disappearing Dirt*, discuss the previous segment to review the problem and go over what the tree house detectives have learned thus far. Download a copy of the Problem Board from the NASA SCI Files™ web site in the "Educators" area under the "Tools" section. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Focus Questions—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.
5. "What's Up?" Questions—Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and point out how the information learned will affect the case. These questions can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 on the Video

For optimal educational benefit, view *The Case of the Disappearing Dirt* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about sand, beach erosion, minerals and their formation, systems, weathering, erosion, and the rock cycle.
4. Organize the information and determine whether any of the students' questions from Segment 1 were answered.
5. Decide what additional information is needed for the tree house detectives to determine what happened to the beach. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
6. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
7. For related activities from previous programs, download the educator guide for *The Case of the Shaky Quake* and/or visit the "Educators" area and click on "Activities/Worksheets" in the menu bar at the top. Scroll down to the "2002–2003 Season" and click on *The Case of the Shaky Quake*.

   In that educator guide, you will find the following:

   a. **Segment 1**—*Layering of the Earth* (pages 18–19); *Did You Catch My Drift?* (pages 21–22); *Plates on the Move*

   b. **Segment 2**—*It's Not My Fault!* (page 33); *Shaky Quake Cake* (page 34)

   In the "Activities/ Worksheet" Section on the Web you will find the following:

   c. *You Got the Whole World in Your Hands; Just How Do Those Plates Move?; Modeled to a Fault; Plates on a Globe*

8. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under "After Viewing" on page 16 and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, problem-based learning activity:
   - **Research Rack**—books, Internet sites, and research tools
   - **Problem-Solving Tools**—tools and strategies to help guide the problem-solving process
   - **Dr. D's Lab**—interactive activities and simulations
   - **Media Zone**—interviews with experts from this segment
   - **Expert's Corner**—listing of Ask-an-Expert sites and biographies of experts featured in the broadcast
9. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the PBL Facilitator Prompting Questions instructional tool found in the "Educators" area of the web site.
10. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. For more assessment ideas and tools, visit the "Educators" area and, in the menu bar, click on "Instructional Tools."

Careers

marine geologist
astronaut
lab technician
paleontologist
geophysical technician
seismologist
chemical engineer

Resources

Books

Baylor, Byrd: *Everybody Needs a Rock*. Simon & Schuster, 1985, ISBN: 0689710518.

Bial, Raymond: *A Handful of Dirt*. Walker & Company, 2000, ISBN: 0802786987.

Cole, Joanna: *Magic School Bus: Inside the Earth*. Scholastic, 2003, ISBN: 0590407600.

Cuff, Kevin: *Stories in Stone*. University of California, Lawrence Hall of Science, 1999, ISBN: 092488620X.

Downs, Sandra: *Shaping the Earth: Erosion*. Millbrook Press, 2000, ISBN: 0761314148.

Gans, Roma: *Let's Go Rock Collecting*. Harper Collins Children's Books, 1997, ISBN: 0064451704.

Harman, Betty: *Moon Rock Heist*. Eakin Press, 1993, ISBN: 0890156670.

Hiscock, Bruce: *Big Rock*. Simon & Schuster, 1999, ISBN: 0689829582.

Hurst, Carol Otis: *Rocks in His Head*. Harper Collins Publishers, 2001, ISBN: 0060294035.

Kittinger, Jo: *Look at Rocks: From Coal to Kimberlite*. Scholastic Library, 1998, ISBN: 053115887X.

Kosek, Jane: *What's Inside the Moon?* Rosen Publishing Group, 2003, ISBN: 0823952827.

Videos

Bill Nye the Science Guy: Rocks and Soil, 1995, Product ID: 68A52VL00.

Bill Nye the Science Guy: Erosion, 1998, Product ID: 68E33VL00.

CD-ROM

Microsoft®: *The Magic School Bus Explores Inside the Earth*. ASIN: B000059ZYQ.

Web Sites

NASA: Lunar Sample Laboratory Facility
Come take a virtual tour of the Lunar Sample Lab and learn how the Moon rocks are kept safe and secure as scientists from around the world study them.
http://curator.jsc.nasa.gov/lunar/lun-fac.htm

NASA: Moon Questions
Find the answers to commonly asked questions about the Moon and Moon exploration.
http://image.gsfc.nasa.gov/poetry/ask/amoonm.html

Edible Rocks
Find delicious recipes for edible rocks on these web sites.
http://www.womeninmining.org/ROCKCOOKIES.pdf
http://www.chariho.k12.ri.us/curriculum/MISmart/rocks/edible.html

ThinkQuest: This Planet Really Rocks
Play the "Name That Rock" game by using pictures and facts about the rocks to identify some common rocks.
http://library.thinkquest.org/J002289/name.html

ThinkQuest: Famous Rock Scavenger Hunt
Investigate the rocks that make up famous monuments and statues in the United States.
http://library.thinkquest.org/J002289/q1.html

Science for Ohio: Hard Rock Café
On this site for students and teachers, learn about the three types of rocks and how they are formed.
http://casnov1.cas.muohio.edu/scienceforohio/Rocks/index.html

Rock Hounds
Explore a series of animated videos, activities, and information about rocks and rock collecting.
http://www.fi.edu/fellows/payton/rocks/index2.html

Rocks for Kids
This site is for kids of all ages who want to learn more about rocks and minerals. Learn how to collect and identify rocks, where to go for more information, and how to order rock samples.
http://www.rocksforkids.com

USGS: Weathering vs. Erosion
Learn the difference between weathering and erosion at this United States Geological Survey (USGS) site.
http://wrgis.wr.usgs.gov/docs/usgsnps/misc/gweaero.html

Weathering and Erosion
Dig a little deeper to learn about the various types of weathering (mechanical and chemical) and erosion.
http://www.marshfield.k12.wi.us/science/biology/eproject/erosion/ero~weather.htm

Activities and Worksheets

In the Guide

On the Web

Edible Rock Families
Make your own igneous, sedimentary, and metamorphic rock cookies as you learn about the characteristics of these rock families.

Don't Take It for "Granite"
Construct a model of granite to learn about the minerals that make up rocks.

Frosty Effects
See how expanding ice can break rocks into pieces.

Walking on Moon Beams

Purpose

To compare how regolith is formed on the Moon and on Earth

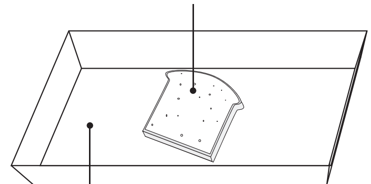
Background

Regolith is the layer of loose, unconsolidated material that forms the surface of the land and covers the bedrock nearly everywhere on both the Earth and the Moon. On Earth, the weathering of the bedrock produces regolith. On the Moon, regolith has apparently been produced by the bombardment of the lunar surface by meteorites, which have broken Moon rocks into smaller and smaller fragments. Generally, on the Moon, the older the surface, the thicker the regolith. Regolith in young areas may be only 2 m thick, while it is perhaps 20 m thick in the older lunar highlands.

Materials

toasted white bread
marbles
aluminum pans
sandpaper
spray bottle with water

Procedure



1. Imagine that the piece of toasted bread is a rock on Earth. The sandpaper is the wind carrying pieces of sand.
2. In your science journal, predict the effect of rubbing the sandpaper across the surface of the bread.
3. Place the toast in a shallow aluminum pan.
4. Rub the sandpaper across the toasted bread.
5. Observe any pieces that are worn away.
6. Record your observations, noting where any pieces fell.
7. Repeat steps 4–6 two or three more times.
8. Using the spray bottle, spray water onto the slice of bread and set it aside.
9. Put a second piece of toast in another pan.
10. Let this piece of toast represent the surface of the Moon and let the marbles represent meteors.
11. Hold one marble about 30 cm above the pan.
12. Drop the marble onto the toast.
13. Observe any pieces that have broken loose.
14. Record your observations in your science journal, being sure to describe the toast and the position of any crumbs that came loose.
15. Continue to drop your meteor 20 times more.
16. Observe the bread and crumbs and record your observation. Note the thickness of the crumb layers.
17. Observe the first bread sprayed with water and note any difference from your first observation.

Conclusion

1. How is the first pan (with the sandpaper and water) like weathering on Earth?
2. What effect do meteors have on the surface of the Moon?
3. What effect do meteors have on the surface of the Earth?
4. In each experiment, where do the crumbs fall?
5. How do the crumbs' locations compare to the location of weathered fragments on Earth and on the Moon?

Extension

- Make your own Moon rocks. Collect several smooth rocks. Paint each rock a light gray color. Create a story about your rocks, describing how they were formed and how they were "collected." Be sure to tell which Apollo mission would have "collected" your rocks.
- Keep a Moon chart for several nights and record your observations of the Moon. Using a telescope or strong binoculars to look at the Moon may be helpful. If you would like to download a Moon chart, visit the "Educators" area of the NASA SCI Files™ web site. Click on "Activities/Worksheets" and then on the 2002–2003 Season. Click on *The Case of the Galactic Vacation* and download "Moonlight of the Night".
- Research the various reasons why it was important for NASA to collect Moon rocks on the Apollo mission. Discuss what we have learned through the years from the Moon rocks. Write a newspaper article explaining what you learned.

The Incredible, Edible Igneous Rock

Problem

To understand how igneous rocks are formed

Background

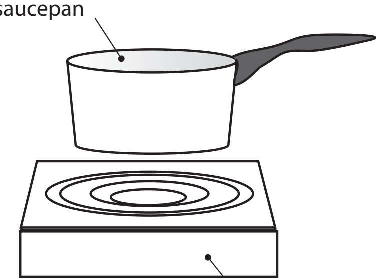
Rocks that have hardened from liquids are called igneous {IG nee us} rocks. The word "igneous" comes from the Greek word for fire. All igneous rocks begin below the Earth's surface in a liquid state of hot melted matter called magma. When magma forces its way to the surface through volcanic eruptions, it is called lava. As magma and lava cool, they form different types of igneous rocks. When magma cools underground, it cools very slowly, forms large crystals, and is called an intrusive igneous rock. When lava cools above ground, it cools more quickly, forms very small or no crystals, and is called extrusive igneous rock.

Materials

6 oz evaporated milk
1/4 tsp salt
1 1/2 cup sugar
1 1/4 cup marshmallows
1 1/2 cup chocolate chips
1 tsp vanilla
margarine
hot plate
can opener
spoon
candy thermometer
pot holders
measuring spoons and cups
timer or clock
9" x 9" pan
paper towels
saucepan

Teacher Note

This activity can be done as a class demonstration or in groups with adult supervision.



Procedure

1. Gather the "minerals" (ingredients) and supplies needed.
2. Carefully observe the individual minerals and record your observations in your science journal.
3. Predict what will happen to the minerals as they are melted and cooled to become edible igneous rocks. Record your prediction in your science journal.
4. Use a paper towel to generously smear margarine on the inside of the pan.
5. In a saucepan, combine milk, sugar, and salt. Stir.
6. With adult supervision, carefully place the saucepan on the hot plate and gently stir the mixture until it comes to a boil.
7. Reduce the heat and simmer the mixture for about five minutes, being sure to stir constantly.
8. Have an adult or your partner carefully place the candy thermometer into the saucepan and continue cooking until the temperature reaches the "soft ball" stage listed on the candy thermometer. **Optional**: If you do not have a candy thermometer, you may test the mixture for a soft ball by dropping a small amount of mixture into a cup of cold water. If a soft ball forms, it's ready; if not, continue cooking and testing until a soft ball stage is reached.
9. When the mixture is ready, use pot holders to carefully remove the pan from the hot plate. To prevent burning the surface, place the pan on a trivet or additional pot holders.
10. Observe the mixture.
11. Continue to stir and carefully add the "minerals": vanilla, marshmallows, and chocolate chips. Observe what happens to each "mineral" as it is added to the mixture.
12. Stir until all "minerals" have melted and mixed into the rock.
13. Spoon the mixture into the pan and let it cool completely.
14. While waiting for the mixture to cool, record your observations for steps 10, 11, and 12. Was your prediction correct?
15. Once the mixture has cooled, cut it into pieces and observe and record your observations. Be sure to illustrate your rocks.
16. Eat and enjoy your edible igneous rocks!

The Incredible, Edible Igneous Rock (concluded)

Conclusion

1. What happened to the "minerals" as you put them into the boiling mixture? Why?
2. Which "mineral" took the longest time to blend into the mixture? The shortest time?
3. How do you know that those same "minerals" are present in the edible igneous rock?
4. Describe how a real igneous rock is produced. Use your cooking experience with the edible igneous rock to help you describe the process.

Extension

1. Collect various igneous rock samples and use a hand lens to observe them. Use rock identification books and identify each sample. Determine whether the sample is an intrusive or extrusive igneous rock.
2. Design a rock garden. Cut off the top of a 2-liter soda bottle and fill it halfway with soil. Arrange various rocks that you have collected on top of the soil. Plant some flower seeds and water your garden. Set the garden in a sunny place and watch it grow.
3. Brainstorm for a list of things made from rocks. Collect pictures to represent the items on your list and create a collage on a poster board or piece of construction paper. Share it with your class.

It's "Sedimentary," My Dear Watson!

Problem

To understand how sedimentary rocks are formed

Materials

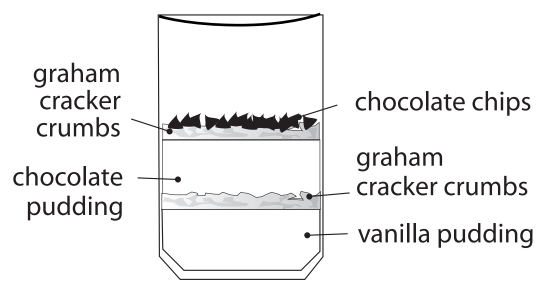
vanilla pudding
chocolate pudding
graham cracker
mini chocolate chips
canned whipping cream
spoons
small plastic cup
paper towels

Background

Seventy-five percent of the rocks at the Earth's surface are sedimentary rocks. They form when sediment becomes pressed or cemented together or when sediments fall out of solution. Sediments are loose materials such as rock fragments, minerals, grains, and small pieces of plant and animal remains that have been transported. Sediments come from already-existing rocks that are weathered and eroded. When sediment is transported and deposited, it builds up layer upon layer of sediments. Pressure from the upper layers pushes down on the lower layers, and if the sediments are very small, they can stick together to form solid rock. This process is called compaction. With larger sediments, pressure alone is not enough to make them stick together. They must be cemented together. Cementation occurs when water soaks through soil and rock and dissolves minerals in the rock. These minerals are natural cement. Sedimentary rocks often form in layers, with the oldest layers on the bottom because they were deposited first. There are two classifications of sedimentary rocks—clastic and nonclastic. Clastic rocks are made of the broken fragments of plants, animals, and other rocks that have been compacted and cemented together. Nonclastic rocks are formed by evaporation, precipitation, or organic deposits.

Teacher Note

The pudding used in this experiment can either be made in class or beforehand from a mix. Individual premade pudding cups also can be used with approximately one cup for every two students.



Procedure

1. Carefully spoon vanilla pudding (about 1/4 of a cup) into the small plastic cup. Make sure to keep the sides of the cup as clean as possible.
2. Break the graham cracker in half and crumble it on top of the vanilla pudding.
3. Spoon chocolate pudding (about 1/4 of a cup) on top of the graham cracker crumbs.
4. Sprinkle a small amount of chocolate chips on top of the chocolate pudding.
5. Crumble the other half of the graham cracker on top of the chocolate chips.
6. In your science journal, describe the sedimentary rock layers in your cup. Illustrate.
7. Place a spoon in the cup so that it rests on the bottom of the cup. Observe and record your observations. Illustrate.
8. When given permission, eat a small corner of your sedimentary rock layers (strata). Observe and record your observations. Illustrate.
9. Use whipping cream to fill in the corner that you ate. Observe and record your observations. Illustrate.
10. When finished, eat and enjoy the rest of your sedimentary rock layers!

It's "Sedimentary," My Dear Watson! (concluded)

Conclusion

1. Are layers of sedimentary rock laid down all at once? Why or why not?
2. How many layers of strata did you have in your cup?
3. Which layer was the oldest? The youngest? How do you know?
4. When you put your spoon into the cup, you crosscut the layers of strata. Was the cut older or younger than the strata? Explain.
5. What did eating a small corner of your strata represent? How does the same thing occur with real sedimentary rocks? What did the whipping cream represent? How does this process occur with real sedimentary rocks?

Extension

1. Investigate the Law of Superposition. Present a report to the class.
2. Add coconut, gummy worms, nuts, and other edible ingredients to represent fossils in the rock layers. Research fossils and present a report on how fossils are formed.
3. Use a geologic time line and other information gained from research to create a story that explains how each layer of your sedimentary rocks was formed and when.
4. Collect samples of sedimentary rocks. Use a rock identification book to identify each sample. Determine whether the sample is clastic or nonclastic.
5. Collect samples of rocks and test them for calcium carbonate to determine which rock type is sedimentary. The main ingredient in sedimentary rocks is calcium carbonate (limestone). To test for calcium carbonate, place a few drops of vinegar on a rock and use a hand lens to check for fizzing. Fizzing means calcium carbonate is present.

"Metamorphically" Speaking

Purpose

To understand how metamorphic rocks are formed

Background

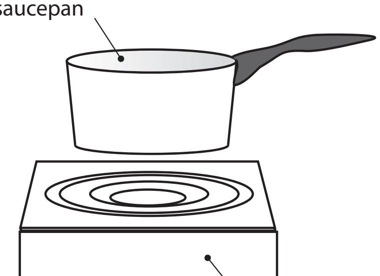
Rocks that have changed due to temperature and pressure increases are metamorphic rocks. Metamorphic means "changed in form," and metamorphic rocks can be formed from changes in igneous, sedimentary, or other metamorphic rocks. Rocks under the Earth's surface are under great pressure from overlying rock layers. They also experience heat created by the radioactive elements in Earth. If the heat and pressure are great enough, the rocks melt and magma forms. In areas where melting doesn't occur, mineral grains change in size and shape, creating a new metamorphic rock. Metamorphic rocks are classified as either foliated or nonfoliated. Foliated rocks are formed when the mineral grains in the rock flatten and line up to create bands or layering. Nonfoliated rocks show no bands or particles.

Materials

6 oz evaporated milk
1/4 tsp salt
1 1/2 cup sugar
1 1/4 cup marshmallows
1 1/2 cup chocolate chips
1 tsp vanilla
margarine
hot plate
can opener
spoon
candy thermometer
pot holders
measuring spoons and cups
saucepan
timer or clock
9" x 9" pan
paper towels

Teacher Note

This activity can be done as a class demonstration or in groups with adult supervision.



Procedure

1. Gather the "minerals" (ingredients) and supplies needed.
2. Carefully observe the minerals and record your observations in your science journal.
3. Predict what will happen to the minerals as they are heated and cooled to become edible metamorphic rocks. Record your prediction in your science journal.
4. Use a paper towel to generously smear margarine on the inside of the pan.
5. In a saucepan, combine milk, sugar, and salt. Stir.
6. With adult supervision, carefully place the saucepan on the hot plate and carefully stir the mixture until it comes to a boil.
7. Reduce the heat and simmer the mixture for about five minutes, being sure to stir constantly.
8. Have an adult or your partner carefully place the candy thermometer into the saucepan and continue cooking until the temperature reaches the "soft ball" stage listed on the candy thermometer. **Optional**: If you do not have a candy thermometer, you may test the mixture for a soft ball by dropping a small amount of mixture into a cup of cold water. If a soft ball forms, it's ready; if not, continue cooking and testing until a soft ball stage is reached.
9. When the mixture is ready, use pot holders to carefully remove the pan from the hot plate. To prevent burning the surface, place the pan on a trivet or additional pot holders.
10. Observe the mixture.

"Metamorphically" Speaking (concluded)

11. Add the vanilla and continue to stir for about 3–5 minutes to cool the mixture slightly.
12. Carefully add the "minerals": marshmallows and chocolate chips. Observe what happens to each "mineral" as it is added to the mixture.
13. Stir, being careful not to let the "minerals" completely melt. Let them form "streaks" as you stir.
14. Spoon the mixture into the pan and let it cool completely.
15. While waiting for the mixture to cool, record your observations for steps 10, 11, and 12. Was your prediction correct?
16. Once the mixture has cooled, cut it into pieces. Observe and record your observations. Be sure to illustrate your rocks.
17. Eat and enjoy your edible metamorphic rocks!

Conclusion

1. Explain what happened to the sponge that was put into the Epsom salts solution.
2. Explain how the sponge is similar to the trees in the Arizona's Petrified Forest.

Extension

1. Use books and other resources to learn more about the Petrified Forest National Park in Arizona.
2. Learn about geologic time and create a geologic time line illustrating the way the Petrified Forest National Park may have looked through each time period, starting with the Triassic Period.
3. The petrified trees of the Petrified Forest National Park were conifers or cone-bearing trees. What kinds of conifers exist today? Make a list of the conifers in your area.
4. Like human beings, trees can become unhealthy and die. Observe nearby trees and note such things as broken branches, holes, unusual leaf color or shape, splits in the wood, or scars. Sketch the tree in your science journal. Develop a hypothesis about what might have happened to each tree. Write a story about the event and share your story with the class.

Rocking Around the Cycle

Problem

To understand the rock cycle

Materials

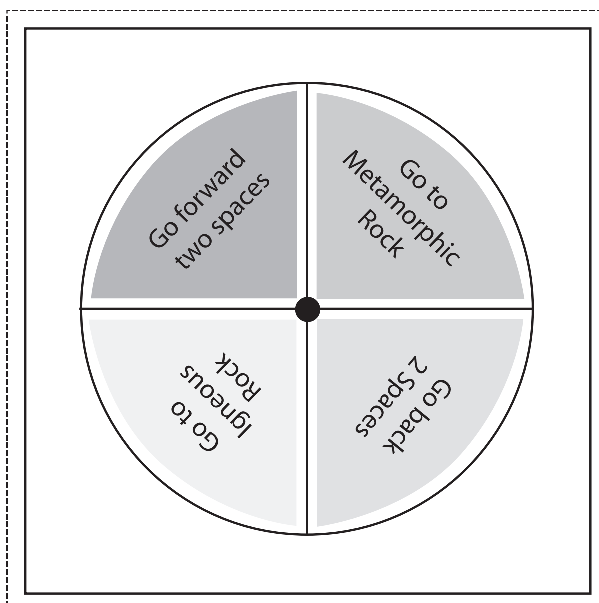
game board
2–4 small pebbles
die
spinner
poster board
brad
glue

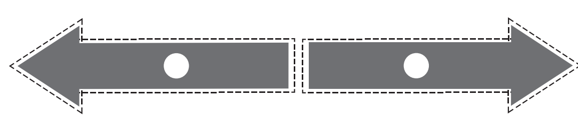
Background

Rocks are classified as igneous, metamorphic, or sedimentary. Igneous rocks form from cooling lava or magma, metamorphic rocks are those that have changed because of temperature and pressure increases, and sedimentary rocks form when sediments become pressed and/or cemented together. Through processes such as weathering, erosion, compaction, cementation, melting, and cooling, rocks can change from one kind of rock to another. The changing of rocks from one form to another is described by the rock cycle. The rock cycle shows how all these things interact to form and change the rocks around you. Play the game to learn more about how the rock cycle works.

Procedure

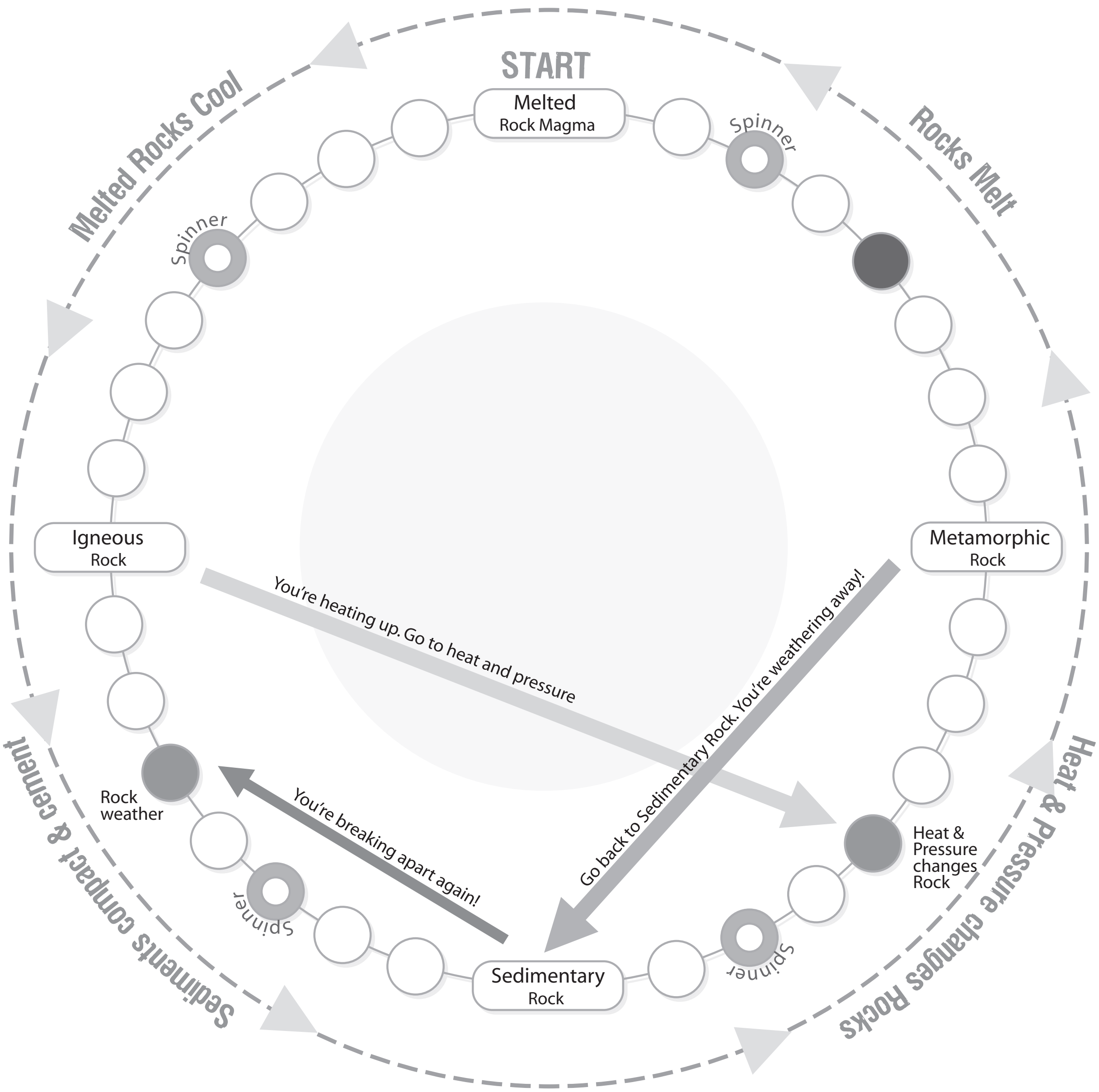
1. To make the spinner
   a. Use scissors to cut along the solid lines of the spinner and arrow piece.
   b. Place the spinner and arrow piece on a small section of poster board and trace around the outer edges.
   c. Cut along the lines that you traced on the poster board.
   d. Glue the spinner and arrow pieces to their appropriate poster board pieces.
   e. With adult supervision, carefully punch a hole in the center of the spinner and at the center of the arrow piece with the sharp end of scissors or a compass.
   f. Using a brad, connect the arrow piece to the center of the spinner.
   g. Spin the arrow to make sure that it spins freely. Adjust it if necessary.
2. To play the game
   a. Each player rolls the die once, and the player with the lowest number goes first. Play will continue around the game board to the right of the first player.
   b. Choose a small pebble to use as your game piece and place it at the "Start" box for magma.
   c. Roll the die once and move your pebble the number of spaces indicated by the die.
   d. Follow the directions on the game board, and if you land on a "Spinner," spin the spinner and follow the directions that the arrow indicates.
   e. The first person to complete the rock cycle and return to magma wins the game.





Rocking Around the Cycle (concluded)

Game Board



"Splitting" on the Ritz

Purpose

To demonstrate how plants break rocks apart

Background

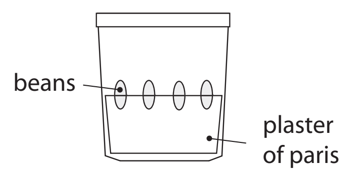
Trees and small plants grow in the soil that collects in the cracks of rocks. As the plant grows larger, the roots push against the sides of the joint in the rock. In time, the rock will split apart along this crack.

Materials

plaster of paris
2 3-oz (90 mL) clear plastic cups
tap water
craft sticks
4 pinto beans
2 paper towels
permanent marking pen

Procedure

1. Mix a small amount of the plaster of paris with water in a disposable container and follow the directions on the box. Note: When finished, do not wash the container because the plaster will clog drains.
2. Fill each plastic cup about 1/3 full with the plaster of paris mixture.
3. In one cup, place the 4 beans on the surface of the mixture, spacing them as far apart as possible.
4. Push the beans into the plaster so that half the bean is below the surface.
5. Use the marking pen to label the container Beans.
6. Use the marking pen to label the other cup Control.
7. Observe each cup and record your observations. Illustrate.
8. Fold each paper towel into fourths by folding it in half twice.
9. Wet the folded towels so they are moist but not dripping.
10. Push one towel into each cup so it fits snuggly against the surface of the plaster.
11. Place the cups where they will not be disturbed for a week.
12. Remove the towels each day for 7 days and observe and record your observations. **NOTE**: It will be necessary to periodically wet the towels to keep them moist.
13. Return the paper towels after each day's observation.



Conclusion

1. What happened to the hardened plaster of paris when the seeds sprouted?
2. Explain how plant roots can break rocks.

Extension

1. Leave the seeds on the surface of the plaster but don't push them down into the wet plaster.
2. Conduct the experiment with different seeds. Does using different kinds of seeds make a difference?
3. Use dry paper towels to cover the cups.

"Weathering" Heights

Purpose

To investigate the difference between mechanical and chemical weathering

Materials

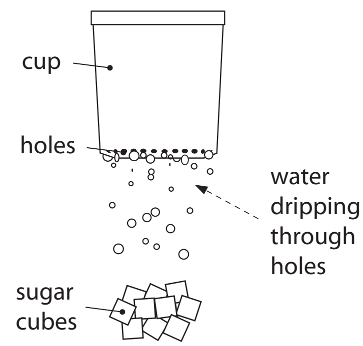
foam cup
sugar cubes
water
marble chips
white vinegar
2 glass beakers or bowls
science journals
scissors

Background

Mechanical weathering is the breaking down of rock into smaller and smaller pieces. The composition of the rock does not change, only its size does. Five different conditions can cause mechanical weathering: temperature, frost, organic activity, gravity, and abrasion. Chemical weathering alters the mineral composition, or the chemical makeup, of the rocks. There are three kinds of chemical weathering: oxidation, carbonation, and acids.

Procedure

1. Put a few sugar cubes in a glass beaker or bowl.
2. With a sharp pencil or scissors, carefully poke several holes in the bottom of the foam cup.
3. Hold the foam cup 30–40 cm above the bowl.
4. Slowly add water to the cup.
5. Observe what happens as the water "rains" down on the sugar cubes.
6. Record your observations in your science journal.
7. Place several marble chips in a glass beaker.
8. Pour white vinegar over the chips until they are covered.
9. Observe what happens to the chips and record your observations.
10. Continue to record your observations of the chips until no further changes can be seen (approximately one to two days).



Conclusion

1. What happens to the sugar cubes when the water hits them?
2. What happens to the marble chips in the vinegar?
3. Which experiment demonstrates chemical weathering? Why?
4. Which experiment demonstrates physical weathering? Why?
5. Why is important for the tree house detectives to understand weathering?

Extensions

1. Hold the cup at different heights and note any differences in the weathering results.
2. Use a rock tumbler to polish rocks. Rock tumblers can be purchased at local toy stores and/or science suppliers. Examine the rocks carefully before you begin the tumbling. After each stage, observe the sludge you remove. When you have finished, create your own museum of beautiful rocks or make jewelry such as pendants and rings. Mountings are fairly inexpensive and can be purchased at lapidary shops and craft stores.

The Oxidizing Oxygen

Purpose

To investigate oxidation as a process of chemical weathering

Materials

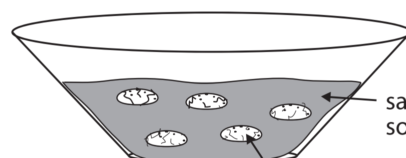
steel wool pads
scissors
shallow non-metal pan
750 mL sand
250 mL potting soil
water
mixing bowl
wooden spoon
science journals

Background

Chemical weathering changes the mineral composition of rocks. Some minerals react with water, oxygen, and/or acids to form new substances. The products of chemical weathering are often softer and smaller than the original rock. Oxidation is one type of chemical weathering. It is a process of combining oxygen with another substance that results in the creation of an entirely new substance. Iron, for example, combines easily with oxygen to form iron oxide, or rust. Red soil gets its color from iron oxide. If a material is colored differently on the inside than on the outside, it may indicate that oxidation is taking place.

Procedure

1. Mix the sand and potting soil together in a bowl.
2. Cut the steel wool pads into 1-cm pieces and add the pieces to the soil and sand. *(Be careful not to get splinters of steel wool in your fingers.)*
3. Stir all ingredients together.
4. Pour the mixture into the shallow pan.
5. Pour enough water over the soil mixture to just cover it.
6. Observe and record your observations in your science journal. Be sure to note the color and texture of the soil.
7. Set the pan in a sunny window.
8. Check the mixture once a day for seven days and record your observations in your science journal. **NOTE**: Depending on the intensity of the Sun, the water may evaporate in a few days. Add water as needed to keep the mixture moist.
9. After a week of observation, describe the process that you observed.



Conclusion

1. What happened to the soil mixture after one week?
2. Compare the texture of the original mixture to the texture of the soil after one week. How has it changed?
3. What do you think will happen if you continue to monitor the soil mixture for another week?
4. What caused the changes in the soil?
5. Why are all the rocks and soil on the Moon the same color?

Extension

Investigate soils from other parts of the country. You can get soil profiles on the Internet. What minerals could cause the different colors in the soil and rock? Find out about the Blue Ridge Mountains. How did they get their name?

Learn more about how weathering affects national monuments such as the Washington Monument, the Statue of Liberty, or Mount Rushmore. What steps are taken to slow down or prevent weathering?

Answer Key

Walking on Moon Beams

1. Agents of erosion, such as wind, water, and ice act on rocks, breaking them apart and transporting the pieces to a new location. As the sandpaper moved across the toast, it broke off small pieces of the bread and deposited them either to the other side of the bread or somewhere else in the pan. The sandpaper represented physical weathering. The water simulated the chemical weathering of rocks here on Earth.
2. Meteors have bombarded the surface of the Moon, breaking the rock into a fine, loose material.
3. Billions of years ago, meteors bombarded the Earth just as they did the Moon. Even today, there are meteor showers. A few even hit the Earth; however, because the Earth has oxygen and water, weathering of the Earth's surface has occurred over time. Therefore, the effects of the meteors from long ago are not as visible as they are on the Moon where there is no weathering.
4. In the experiment with the sandpaper, the crumbs are moved to the edges of the toast and off the edge into the pan. In the marble experiment, the crumbs stay in the same location; they just form a deeper layer.
5. On Earth, weathered pieces of rock are transported from where they are broken down by wind, water, ice, and gravity. On the Moon, the loose, fragmented regolith remains near the impact area, forming deeper layers.

The Incredible, Edible Igneous Rock

1. When the "minerals" were put into the hot mixture, they began to melt. They continued to melt until they were no longer recognizable as individual minerals and were blended into the mixture. Each mineral has a melting point, which is the temperature at which it will begin to melt. The mixture was either at or beyond the melting point for each of the minerals added to the mixture.
2. Answers might vary, but generally the chocolate chips take longer to blend into the mixture than the marshmallows because the chocolate chips are more solid. The vanilla took the shortest time to blend because it was already in liquid form.
3. You know the minerals are there because you can taste them and even see the chocolate color (chocolate chips). The texture is also creamy from the marshmallows.
4. Answers will vary but should include that minerals in the Earth's crust are like the minerals in the activity. The high temperatures found beneath the surface of the Earth heat minerals, and once they reach their melting point, they melt and form magma. Magma can either cool under the Earth and form intrusive rocks, or it can come to the surface of the Earth as lava, which, when cool, forms extrusive rocks.

It's "Sedimentary," My Dear Watson!

1. No. Layers of sedimentary rocks are laid down one at a time because sediments are deposited slowly over time.
2. There were five layers: vanilla pudding, graham cracker, chocolate pudding, and chocolate chip.
3. The oldest layer was the vanilla pudding because it was laid down first. The youngest layer was the graham cracker layer on top because it was laid down last.
4. The cut made by the spoon was younger because it happened after all the layers were laid down.
5. Eating a small corner of the strata represented weathering and erosion. Sedimentary rocks are weathered by either mechanical or chemical processes and then are transported (eroded) by wind, water, and ice.
6. The whipping cream represented deposition of new sediment. After sediments are weathered, they are carried by wind, water, and ice to a new location where they are deposited to begin the formation of new sedimentary rocks.

"Metamorphically" Speaking

1. The minerals didn't completely melt because the mixture was not hot enough.
2. Answers will vary, but the chocolate chips usually take longer to melt because they have more mass (are thicker) and are more solid.
3. Answers will vary.

"Splitting" on the Ritz

1. The hardened plaster of paris cracked as the roots began to grow.
2. The plant roots occupy the spaces and small cracks found in rocks. As the plant grows, it pushes against the sides of these joints, causing the rock to split apart.

Answer Key (concluded)

"Weathering" Heights

1. The sugar cubes began to dissolve as the water was added.
2. The marble chips began to dissolve as the vinegar combined with the calcium carbonate in the chips. Bubbles of carbon dioxide were released as a byproduct.
3. The vinegar and marble chips represent chemical weathering because a chemical change is taking place in the minerals that make up the rock.
4. The sugar cubes experiment represents mechanical weathering because the sugar cubes change shape but are not chemically altered.
5. The tree house detectives need to understand how sand is formed to understand where it has gone.

The Oxidizing Oxygen

1. The soil mixture begins to turn red as the steel wool oxidizes.
2. The texture of the soil is softer than the original soil.
3. As the steel wool continues to break down, the soil mixture will become a darker rust color and the larger pieces within the mixture will become smaller and more fragile.
4. As water is introduced to the steel wool, oxygen begins to combine with the iron to form iron oxide (rust).
5. Because there is no water or oxygen, rocks and soils do not oxidize on the Moon.

On the Web

Edible Rock Families

1. Answers will vary but should include characteristics of each rock type.

Don't Take It for "Granite"

1. Quartz, feldspar, and mica (hornblende) make up granite.
2. Answers will vary but should include that the granite samples are different colors and/or have crystals of different sizes.
3. The almost endless combination of pressures, temperatures, and cooling rates makes the granite look different. Although all granite is made up of the same minerals, each rock has a unique amount of each mineral.
4. All granite rocks have the same minerals present.
5. As magma cools, crystals form and the liquid rock forms a solid.

Frost Action

1. After the water froze, the plugs were pushed out beyond the ends of the straw to accommodate the water's expansion.
2. As water fills the cracks in rocks and freezes because of lower temperatures, it expands. The ice pushes against the joints in the rocks. Continued freezing and thawing weakens the structure of the rock, eventually leading to its breaking.
3. When the ice inside the straw melts, the plugs move in toward the center of the straw again.
4. No evidence of chemical change occurs; the water simply changes state and occupies more space.